Millikin University
Student Learning in the Mathematics and Computer Science Major
By Daniel Miller
July 1, 2012

Executive Summary

The Department of Mathematics supports Millikin's Mission in that the Department works:

1. To prepare students for professional success.
    a. Applied mathematics – we provide core mathematical experiences and a range of application areas to prepare students for work or graduate study.
    b. Mathematics education – we prepare students for the Illinois State Certification Exam, give them experience in teaching, and keep them current on the use of technology in mathematics education.

2. To prepare students for democratic citizenship in a diverse and dynamic global environment.
    a. Applied mathematics- we provide fundamental tools to analyze dynamic events that will inform public policy.
    b. Mathematics education- in a world where political leaders are becoming increasingly numbers driven, we provide the teachers the skills to empower children by enhancing their ability to reason quantitatively.

3. To prepare students for a personal life of meaning and value we help our students develop the intellectual framework, and instill in them the mindset, that will enable them to remain life-long learners. Our students are taught to think rigorously and rationally, and to revel in the sheer pleasure of thinking.

Additionally, the department has specific goals for two of its majors Applied Mathematics, and Mathematics Education. These goals clarify and document the department's desire to produce highly qualified and successful majors. The University completed the paperwork for the Actuarial Science program to receive VEE credit for applied statistical methods (through 2013), time series (through 2013), corporate finance (through 2014), and economics (through 2014). A complete assessment of this program will be completed by Dr. Beck with consolation from the School of Business when the program is viewed as sustainable. We expect the only assessment criteria beyond those of mathematics major will be to track actuarial exam scores for student who choose this option.

The assessment results for data collected from July 2011- July 2012 constitute the department's ongoing systemic attempt to quantify student achievement within the department. The results suggest that for students in both Mathematics and Mathematics Education program goals are being met. Additionally, Mathematics Education maintains NCATE special program accreditation from NCTM. There should be no additional assessment data necessary for the mathematics education major beyond what is collected for the yearly NCATE report.

Report

Goals

The Department of Mathematics supports the mission of the university in preparing students for professional success, democratic citizenship in a global community, and a personal life of meaning and value. The mission of the department is to produce graduates who achieve the following learning outcome goals:

1. Applied Mathematics

   An applied mathematics major will

   a. be able to integrate and differentiate functions,
   b. be able to express and interpret mathematical relationships from numerical, graphical and symbolic points of view,
   c. be able to read and construct mathematical proofs in analysis and algebra, and
   d. be able to apply mathematics to at least two areas taken from biology, physics, chemistry, economics or computer science.

2. Mathematics Education

   A mathematics education major will

   a. be able to pass the Illinois high school mathematics certification exam,
   b. know in broad terms the history of calculus, algebra, and probability,
   c. have prepared at least 2 lesson plans in mathematics, and
   d. have served as an teaching intern for a member of the mathematics faculty

These goals also reflect a connection to Millikin's Mission in that the Department works:

4. To prepare students for professional success.
   a. Applied mathematics – we provide core mathematical experiences and a range of application areas to prepare students for work or graduate study.
   b. Mathematics education – we prepare students for the Illinois State Certification Exam, give them experience in teaching, and keep them current on the use of technology in mathematics education.
   c. Computer science – we train students in fundamental programming techniques and theory so that they can learn new technologies in this rapidly changing field.

5. To prepare students for democratic citizenship in a diverse and dynamic global environment.
   a. Applied mathematics- we provide fundamental tools to analyze dynamic events that will inform public policy.

b. Mathematics education- in a world where political leaders are becoming increasingly numbers driven, we provide the teachers the skills to empower children by enhancing their ability to reason quantitatively.
c. Computer science- we provide the skills necessary for students to succeed in an increasingly technological world

3. To prepare students for a personal life of meaning and value we help our students develop the intellectual framework, and instill in them the mindset, that will enable them to remain life-long learners. Our students are taught to think rigorously and rationally, and to revel in the sheer pleasure of thinking.

Snapshot

The Department of Mathematics guides students in the completion of three different majors: mathematics education, applied mathematics and actuarial science. Currently, 24 students are following one of our major programs of study.

General Description. The Department of Mathematics includes the disciplines of mathematics and statistics. The department offers mathematic majors with options in Applied Mathematics, Mathematics- Secondary Teaching, and Actuarial Science. Additionally, a minor in Applied Mathematics is offered. Elementary Education majors may take a concentration in mathematics. The curriculum is structured to meet the overlapping needs of students who fall in one or more of the following categories:

- those who plan to become high school mathematics teachers;
- those who intend to pursue graduate work in applied mathematics, computer science, or other related fields; and
- those who will apply mathematics and/or computer science in the natural sciences, social sciences, business or other areas of quantitative studies such as actuarial science.

Additional Comments.

- The three majors offered in the Department share courses and faculty. The applied mathematics and mathematics secondary education majors are particularly entwined with students taking common courses and interacting with the same faculty members. In many respects these two majors cannot be disentangled for analysis.
- Students can earn either the Bachelor of Arts or Bachelor of Science. The choice of B.A. or B.S. depends entirely on the student's interest in studying a foreign language. There is no distinction in Departmental coursework between the B.A. and B.S. degrees. Therefore, this report will not separate the B.A. from the B.S.
- All fulltime tenure-track members of the Department have doctorate degrees. (See Table 1.) The department continues to **rely heavily** on adjunct faculty for most of our developmental offerings (12 of 21, traditional program spring 12 4 of 7 fall 11 4 of 10, PACE 4 of 4).

Description Applied Mathematics**.** The applied mathematics major is for students interested in immediate employment or further study in applied mathematics or in actuarial sciences. Applied mathematics majors take a minimum of 33 credit hours in mathematics. The core courses and required advanced courses are those specified in *Undergraduate Programs and Courses in the Mathematical Sciences: CUPM Curriculum Guide 2004* by the Committee on the Undergraduate Program in Mathematics of The Mathematical Association of America.

Description Mathematics Education. The Mathematics-Secondary Teaching major is a rigorous course of study in mathematics and education. The major has 38 required credit hours in mathematics. Unique among institutions of comparable size we require a mathematics teaching internship experience as part of our program. During this experience the student is paired with a member of the faculty in teaching an undergraduate mathematics course.

Description Actuarial Science Concentration. This option is a rigorous treatment of the mathematics and business skills necessary for a major to enter the workforce as an entry-level actuary. Students who completed this option and all highly recommended courses in business will be prepared to take the first two Actuarial Examinations (1/P and 2/FM) of the Casualty Actuarial Society and the Society of Actuaries. The department is currently working with Tabor School of Business to offer additional course to our majors to prepare them for additional exams. Currently through this corporation, Millikin students can obtain Verification of Educational Experiences (VEE) credit from the Society of Actuaries (SOA) in Applied Statistical Methods (through 2013), Corporate Finance (through 2014), and Economics (through 2014) (see table in appendix).

<u>The Learning Story</u>

Applied mathematics and mathematics education majors follow nearly the same curriculum within the Department. The Department believes that to be a good mathematics teacher one needs to know mathematics. Therefore, the education majors are expected to successfully compete with the applied majors in most of their mathematics courses. The program assumes entering students can start with calculus the fall of their freshmen year. Additionally, education majors are advised to have completed the core of their mathematics courses by the spring of their junior year so that they are prepared for the state certification examination that must be passed prior to being placed for student teaching.

The applied mathematics curriculum focuses on the integration of mathematical theory and mathematical practice. Our majors learn concepts and techniques appropriate for actuarial science, ecological modeling, engineering, numerical analysis, and statistical inference. We assume that most of our applied mathematics major will seek employment in commerce or industry, but the curriculum also prepares them for post-graduate work in mathematics.

The current curriculum maps are included as Appendix 1-2.

<u>Assessment Methods</u>

All students are required to pass the Millikin mathematics placement exam prior to taking a QR course or receive an equivalent math ACT score. In the past, the Department expected our majors to score an ACT math sub score of 28 or higher or a placement score of 5 (the suggested score for placement into Calculus I). The Department now tests all students wanting to take Calculus with the Millikin Calculus readiness exam and students are placed by the score obtained on the exam. Students are assessed within our programs in numerous ways: course exams, problem sets, and written and oral demonstrations. Additionally, the Department requires every student in Mathematics Education to complete an internship. Written evaluations from these experiences including evaluation by the students' supervisors are kept. Mathematics Education majors take and pass the state certification examination and submit to a portfolio review. Applied Mathematics majors lead a graduate school like seminar their last semester.

Assessing the Applied Mathematics Major Goals

An applied mathematics major will

1. be able to integrate and differentiate functions,

   All Applied Mathematics majors are required to take and pass both Calculus I and Calculus II to graduate with an Applied Mathematics degree. It is the consensus of the department that it would not be possible to pass these two courses without the ability to integrate and differentiate functions. Therefore, verifying the completion of these two courses by all Applied Mathematics majors will assess fulfillment of this goal. Additionally, the department chair will collect copies of all Calculus I and Calculus II final exams each semester to verify the assertion that integration and differentiation of functions was necessary to pass the exams.

   a. In the spring of 2011 the department chair collected copies of all Calculus I and II final exams. The instructors for each course were asked to verify that no student could pass the exam without having knowledge how to integrate and differentiate functions. The department chair then independently verified this conclusion. The collected data in being maintained by the departmental chair and is included at the end of this document.

2. be able to express and interpret mathematical relationships from numerical, graphical and symbolic points of view,

   All Applied Mathematics majors are required to take and pass Discrete Mathematics, Differential Equations, and Numerical Analysis. It is the consensus of the department that it would not be possible to pass these three courses without the ability to express and interpret mathematical relationships from numerical, graphical and symbolic points of view. Therefore verifying the completion of these courses by all Applied Mathematics majors will assess fulfillment of this goal. Additionally, the department chair will collect copies of all Discrete Mathematics, Differential Equations, and Numerical Analysis final exams each semester to verify the assertion that expressing and interpreting mathematical relationships from numerical, graphical and symbolic points of view was necessary to pass the exams.

a. See attached final exams and reviews of these finals by the individual faculty members.

3. be able to read and construct mathematical proofs in analysis and algebra, and

All Applied Mathematics majors are required to take and pass Discrete Mathematics, Calculus III and Linear Algebra. It is the consensus of the department that it would not be possible to pass these three courses without the ability to read and construct mathematical proofs in analysis and algebra. Therefore verifying the completion of these two courses by all Applied Mathematics majors will assess fulfillment of this goal. Additionally, the department chair will collect copies of all Discrete Mathematics, Calculus III and Linear Algebra final exams each semester to verify the assertion that reading and constructing mathematical proofs in analysis and algebra was necessary to pass the exams.

a. Discrete Mathematics, Calculus III and Linear Algebra were all offered this year. A copy of the final exams from Calculus III and Linear Algebra are attached. A review of these exams support the contention that it would not be possible to pass these three courses without the ability to read and construct mathematical proofs in analysis and algebra. See attached final exams and reviews of these finals by the individual faculty members.

4. be able to apply mathematics to at least two areas taken from biology, physics, chemistry, economics or computer science.

All Mathematics majors are required to take Calculus I and II and Discrete Mathematics. The final exams from all sections of these courses will be review by the department chair to ensure that these routinely contain problems from biology, physics, chemistry, economics or computer science. Specifically, physics will be covered in Calculus I; biology, chemistry, and economics in Calculus II, and computer science applications in Discrete Mathematics.

a. This review was completed and verified that the exam contained appropriate problems involving biology, physics, chemistry, economics or computer science. All final exams for these courses are attached. Again, see attached final exams and reviews of these finals by the individual faculty members.

Assessing the Mathematics Education Major Goals

A mathematics education major will

1. be able to pass the Illinois high school mathematics certification exam,

The department chair will verify that each Mathematics Education major has passed the state certification exam prior to student teaching. Additionally, the chair will note and analyze the subject area sub scores on an ongoing basis to determine the need for curricular change.

a. Two out of three students passed the state secondary content exam. Note the state wide passing rate was below 50%.
b. The program is nationally accredited!!

2. know in broad terms the history of calculus, algebra, and probability,

   All Mathematics Education majors are required to take and pass Mathematics History to graduate with an Mathematics Education degree. It is the consensus of the department that it would not be possible to pass this course without knowing in broad terms the history of calculus, algebra, and probability. Therefore verifying the completion of this course by all Mathematics Education majors will assess fulfillment of this goal. Additionally, the department chair will audit the Mathematics History syllabus each semester to verify the assertion that the assignments cover the history of calculus, algebra, and probability. Samples of student work will also be collected.

   a. Math History was not offered this year.

3. have prepared at least 2 lesson plans in mathematics, and

   All Mathematics Education majors will be required to submit 2 graded lesson plans to the department chair prior to student teaching. These lesson plans may come from a variety of courses; MA 425 Teaching Secondary and Middle School Mathematics, MA 471 Mathematics Internship, or any other education course that required the completion of a mathematics lesson plan.

   a. Lesson plans for MA 425 and MA471 were collected and reviewed by the department. Dr. Paula R. Stickles has taken over this assessment.

4. have served as a teaching intern for a member of the mathematics faculty

   In support of this goal, all Mathematics Education majors are required to take and pass the departmental teaching internship MA 471 to graduate with a Mathematics Education degree. The departmental chair will collect and analyze the end of course reflection required for this internship to determine the effectiveness of the experience.

   a. All secondary mathematics majors taking MA 471 were required to complete an end of course reflection. These reflections were reviewed by Dr. Paula R. Stickles and she has taken over this assessment.

Assessing the Actuarial Science Major Goals.
An assessment program for the new actuarial science is also under development. Currently the number of students in the program is too small to accurately access.

Analysis of Assessment Results

The assessment data collected for 2011-2012 constitutes the department's second systemic attempt to quantify student achievement within the department. The results suggest that for students in both Mathematics and Mathematics Education program goals are being met. Assessment of the Actuarial Science program will be delayed until enrollment increases.

Review of 2011-2012 Improvement Plans

- Assign a permanent faculty member to oversee MA 471 as part of load
    - This was instituted and Dr. R. Stickles has been placed in charge.
- Redesign the developmental and QR sequence to better match the current student body and faculty lines
    - A new developmental course "College Arithmetic" will begin fall 1202.
    - Dr. Rauff has agreed to develop and assess this course
- Develop a new method for calculus placement
    - Starting fall 2012 all students wanting calculus will be required to pass the new Millikin Calculus readiness exam.
- Obtain a fulltime faculty line for developmental mathematics at the instructor level
    - We continue to **FAIL** at convincing the University of our needs for an additional line for developmental mathematics (see data above).
- Obtain a funding line within the department for undergraduate research
    - The university has developed some support in this area
- Develop an intradepartmental marketing program
    - We continue to work on this

2012-2013 Improvement Plans

- Move all developmental mathematics courses to pass fail. We believe this will improve student performance as they move into QR classes and beyond.
- Obtain funding for a fulltime instructor position to work teach developmental mathematics and PACE course.
- Change QR requirements to continue to reduce the number of mathematics courses students have to take if their major is not mathematics intensive.

Student Publications and Presentations
Department of Mathematics
2010-2012

Peck, H. Summer Undergraduate Research Fellowship, Millikin University. One of five recipients. (Summer 2012)

Bloome, L. Accepted to the Summer Mathematics Institute at Cornell University, Ithica, NY. One of twelve participants in a summer program learning analysis and completing a research project (June-July 2012)

Bloome, L. Conference Presentation. *Connections between Central Sets and Cut Sets in Zero-Divisor Graphs of Commutative Rings*, Rose-Hulman Undergraduate Mathematics Conference, Terre Haute, IN, twenty minutes. Recognized as one of the five best talks of the conference. (April 2012)

Buhrmann, J. Conference Presentation. *The U.S. Life Insurance Industry: Time Series Analysis*, Rose-Hulman Undergraduate Mathematics Conference, Terre Haute, IN, twenty minutes. Recognized as one of the five best talks of the conference. (April 2012)

Perkins, M. Conference Presentation. *The Predicted Success Rate in Lower 10 Percent of Accepted Students*, Rose-Hulman Undergraduate Mathematics Conference, Terre Haute, IN, twenty minutes. Recognized as one of the five best talks of the conference. (April 2012)

Woods, M. Conference Presentation. *Good or Bad: Lowering Entrance Standards*, Rose-Hulman Undergraduate Mathematics Conference, Terre Haute, IN, twenty minutes. Recognized as one of the five best talks of the conference. (April 2012)

Lee, E., Lee, S., Elliot, D., Mathy, K., and **Walker, D.** Interval Estimation for Extreme Value Parameter with Censored Data, *ISRN Applied Mathematics* (2011), Article ID 687343, 1-12.

Weber, D. Zero-Divisor Graphs and Lattices of Finite Commutative Rings, *Rose-Hulman Undergraduate Math Journal*, **12** (2011), no. 1.

Coté, B., Ewing, C., Huhn, M. and Plaut, C., **Weber, D.** Cut-sets in Zero-Divisor Graphs of Finite Commutative Rings, *Communications in Algebra*, **39** (2011), no. 8, 2849-2864

Bloome, L. Conference Presentation. *Compressed Zero-Divisor Graphs of Finite Commutative Rings*, University of Dayton Undergraduate Mathematics Day, Dayton, OH, fifteen minutes (November 2011)

Morin, M. Conference Presentation. *Formalizing Course Materials for a Quantitative Reasoning Course*, University of Dayton Undergraduate Mathematics Day, Dayton, OH, fifteen minutes (November 2011)

Stickles, P. and **Morin, M.** Conference Presentation. *Undergraduate Fellows Program AKA Getting an Undergraduate to Do Your Work and Enjoy it!* Annual Meeting of the Illinois Council of Teachers of Mathematics. Springfield, IL, sixty minutes (October 2011)

Stickles, J., **Helding, C.**, and **Morin, M.** Conference Presentation. *Undergraduate Teaching Internship Program at Millikin University*, Annual Meeting of the Illinois Council of Teachers of Mathematics. Springfield, IL, sixty minutes (October 2011)

Lee, E., Lee, S., Elliot, D., Mathy, K., and **Walker, D.** Interval Estimation for Extreme Value Parameter with Censored Data, ISRN Applied Mathematics (2011), Article ID 687343, 1-12.

Weber, D. Zero-Divisor Graphs and Lattices of Finite Commutative Rings, Rose-Hulman Undergraduate Math Journal, 12 (2011), no. 1, 58-70.

Coté, B., Ewing, C., Huhn, M. and Plaut, C., **Weber, D.** Cut-sets in Zero-Divisor Graphs of Finite Commutative Rings, Communications in Algebra, 39 (2011), no. 8, 2849-2864

Weber, D. James Millikin Scholar Project. Zero-Divisor Graphs and Zero-Divisor Lattices of Finite Commutative Rings. Received Outstanding JMS Project Award. (May 2011)

Stickles, P., **Helding, C., and Smith, B.** Conference Presentation. Authentic Teaching Experiences in Secondary Mathematics Methods Courses. Annual Meeting of the National Council of Teachers of Mathematics. Indianapolis, IN, sixty minutes (April 2011)

Bloome, L. Conference Presentation. Compressed Zero-divisor Graphs of Finite Commutative Rings, Rose-Hulman Undergraduate Mathematics Conference, Terre Haute, IN, twenty minutes (March 2011)

Luciano, G. Conference Presentation. Using Data Mining to Determine Academic Success in College, Rose-Hulman Undergraduate Mathematics Conference, Terre Haute, IN, twenty minutes (March 2011)

Weber, D., Conference Presentation. A Preliminary Look at Compressed Zero-Divisor Graphs and Zero-Divisor Lattices, Rose-Hulman Undergraduate Mathematics Conference, Terre Haute, IN, twenty minutes (March 2011)

Bloome, L. and Weber, D. Poster Presentation. Compressed Zero-Divisor Graphs and Zero-Divisor Lattices of Finite Commutative Rings, Joint Mathematics Meetings, New Orleans, LA. (One of twenty $100 prize winners out of over 250 posters. (January 2011)

Coté, B., Ewing, C., Huhn, M. and Plaut, C., **Weber, D.** Cut-sets in Cut-Vertices in the Zero-Divisor Graph of , Rose-Hulman Undergraduate Math Journal, 11 (2010), no. 1, 1-8.

Bloome, L. Conference Presentation. Compressed Zero-divisor Graphs of Finite Commutative Rings, Millikin Undergraduate Mathematics Research Conference, Decatur, IL, twenty minutes (November 2010)

Luciano, G. Conference Presentation. Using Data Mining to Analyze Admissions Data, Millikin Undergraduate Mathematics Research Conference, Decatur, IL, twenty minutes (November 2010)

Weber, D., Conference Presentation. Zero-Divisor Lattices on Commutative Rings, Millikin Undergraduate Mathematics Research Conference, Decatur, IL, twenty minutes (November 2010)

Weber, D., Conference Presentation. Cut-Vertices and Cut-Sets on Zero-Divisor Graphs, Special Session in Commutative Rings, AMS Sectional Meeting, St. Paul, MN, twenty minutes (April 2010)

Weber, D., Conference Presentation. Cut-Sets in Zero-Divisor Graphs of Finite Commutative Rings, Rose-Hulman Undergraduate Mathematics Conference, Terre Haute, IN, twenty minutes (March 2010)

Arn, R. and Miller, D., Conference Presentation. Combatting Noise in Imaging Systems, Rose-Hulman Institute of Technology Undergraduate Mathematics Research Conference, Terre Haute, IN, twenty minutes (March 2010)

Weber, D., Poster Presentation. Cut-Sets and Cut-Vertices on Zero-Divisor Graphs, Joint Mathematics Meeting, San Francisco, CA (January 2010)

Table 1. Full time faculty: Mathematics

Faculty	Highest Degree	Rank	Tenure Status	Year Hired	Specialty Field	Courses taught
James Rauff	Ph.D.	Professor	Tenured	1988	Formal Languages, Computational Linguistics, Ethnomathematics.	Discrete Math, Computing Theory, History of Math, Linear Algebra, Calculus, Remedial Algebra.
Randal Beck	Ph.D.	Associate Professor	Tenured	1979	Partial Differential Equations, Statistics.	Calculus, Statistics, Differential Equations.
Daniel Miller	Ph.D.	Professor	Tenured	1997	Mathematics Education, Geometry, Educational Technology.	Teaching Methods, Precalculus, Geometry, Remedial Algebra
Joe Stickles	Ph.D.	Professor	Tenured	2006	Ring Theory.	Calculus, Liberal Arts Mathematics, Abstract Algebra.
Eun-Joo Lee	Ph.D.	Assistant Professor	Tenured	2006	Mathematical Statistics.	Statistics, Calculus.
Paula Stickles	Ph.D.	Associate Professor	Tenured	2006	Problem Solving/Posing, Mathematical Modeling	Secondary Methods, Calculus, Mathematics Content for Elementary Teachers

Appendix 1

Curriculum Matrix
Applied Mathematics

	MA 140	MA 208	MA 240	MA 303	MA 304	MA 305	MA 313	MA 340	MA 403	MA 440	MA 499		MA 308	MA 314	MA 320	MA 420	MA 472	MA 491
Goal 1																		
Goal 2																		
Goal 3																		
Goal 4																		
				Required Course									Elective Courses (Two-required)					

An applied mathematics major will

Goal 1: be able to integrate and differentiate functions.

Goal 2: be able to express and interpret mathematical relationships from numerical, graphical and symbolic points of view.

Goal 3: be able to read and construct mathematical proofs in analysis and algebra.

Goal 4: be able to apply mathematics to at least two areas taken from biology, physics, chemistry, economics or computer science.

Appendix 2

Curriculum Matrix
Mathematics Education

	MA 140	MA 240	MA 208	MA 301	MA 303	MA 304	MA 320	MA 425	MA 471		MA 340	MA 403	MA 305	MA 313	MA 314	MA 420	MA 440
Goal 1																	
Goal 2																	
Goal 3																	
Goal 4																	
		Required Course									Elective Courses (Two-required)						

Goal 1: A mathematics education major will be able to pass the Illinois high school mathematics certification exam.

Goal 2: A mathematics education major will know in broad terms the history of calculus, algebra, and probability.

Goal 3: A mathematics education major will have prepared at least 4 lesson plans.

Goal 4: A mathematics education major will have served as a teaching intern for a member of the mathematics faculty.

Detailed Assessment of Selected Courses and Final Exams

Assessment of MA 140 Final Exam for Fall 2011

Goal: An applied mathematics major will be able to integrate and differentiate functions.

Assessment of goal:

Differentiation: Of the 18 problems on this final exam, problems 2, 4, 5, and 6 on the calculator part, and problems 1, 5, 6, and 7 on the non-calculator part either explicitly or implicitly required the students to take a derivative of some function in order to be able to solve the problem. Problem 1 on the non-calculator part required the students to understand the definition of the derivative. Problem 7 on the non-calculator part required the students to connect the first derivative of a function with the function increasing or decreasing and to connect the second derivative with the concavity of the function. Problem 2 on the calculator part required the students to apply differentiation techniques without having an explicitly stated function. Problem 4 on the calculator part required students to connect the derivative to optimizing a quantity given certain restrictions. Problem 5 on the calculator part required students to connect the derivative to a change in quantities with respect to time (related rates).

Integration: Of the 12 problems on this final exam, problems 2, 8, and 9 on the non-calculator part, and problem 7 on the calculator part either explicitly or implicitly required students to integrate some function in order to be able to solve the problem. Problem 2 on the non-calculator part required the students to understand the definition of the definite integral to obtain the exact value of the definite integral. The remaining problems either explicitly or implicitly required students to integrate some function in order to be able to solve the problem.

As nearly every problem on this final exam involved either differentiation or integration (or both), it would be impossible for a student to pass this exam without knowing how to differentiate or integrate functions.

Goal: An applied mathematics major will be able to apply mathematics to at least two areas taken from biology, physics, chemistry, economics, or computer science.

Assessment of Goal: Problem 7 on the calculator part dealt with estimating integrals from a table of values; in particular. Since science students will be making inferences using experimental data, the ability to estimate derivatives and integrals from a table of values will be extremely useful. Problem 4 on the calculator part required students to determine the minimum value of some physical quantity. Though this particular problem did not explicitly bring in physics or chemistry per se, the technique required to solve this problem *does* occur in solving problems in physics and chemistry, and therefore, students who successfully completed this problem have learned a technique they can use to solve application problems in physics and chemistry. Also, problem 5 on the calculator part involved differentiation to determine the rate of change of a physical quantity with respect to another physical quantity, which is a topic from physics.

MA140 Fall 2011
Final

Assessment of MA 140 Final Exam for Spring 2012

Goal: An applied mathematics major will be able to integrate and differentiate functions.

Assessment of goal:

Differentiation: Of the 18 problems on this final exam, problems 2, 4, 5, and 6 on the calculator part, and problems 1, 5, 6, and 7 on the non-calculator part either explicitly or implicitly required the students to take a derivative of some function in order to be able to solve the problem. Problem 1 on the non-calculator part required the students to understand the definition of the derivative. Problem 7 on the non-calculator part required the students to connect the first derivative of a function with the function increasing or decreasing and to connect the second derivative with the concavity of the function. Problem 2 on the calculator part required the students to apply differentiation techniques without having an explicitly stated function. Problem 4 on the calculator part required students to connect the derivative to optimizing a quantity given certain restrictions. Problem 5 on the calculator part required students to connect the derivative to a change in quantities with respect to time (related rates).

Integration: Of the 12 problems on this final exam, problems 2, 8, and 9 on the non-calculator part, and problem 7 on the calculator part either explicitly or implicitly required students to integrate some function in order to be able to solve the problem. Problem 2 on the non-calculator part required the students to understand the definition of the definite integral to obtain the exact value of the definite integral. The remaining problems either explicitly or implicitly required students to integrate some function in order to be able to solve the problem.

As nearly every problem on this final exam involved either differentiation or integration (or both), it would be impossible for a student to pass this exam without knowing how to differentiate or integrate functions.

Goal: An applied mathematics major will be able to apply mathematics to at least two areas taken from biology, physics, chemistry, economics, or computer science.

Assessment of Goal: Problem 7 on the calculator part dealt with estimating integrals from a table of values; in particular. Since science students will be making inferences using experimental data, the ability to estimate derivatives and integrals from a table of values will be extremely useful. Problem 4 on the calculator part required students to determine the minimum value of some physical quantity. Though this particular problem did not explicitly bring in physics or chemistry per se, the technique required to solve this problem *does* occur in solving problems in physics and chemistry, and therefore, students who successfully completed this problem have learned a technique they can use to solve application problems in physics and chemistry. Also, problem 5 on the calculator part involved differentiation to determine the rate of change of a physical quantity with respect to another physical quantity, which is a topic from physics.

MA140 Spring 2012
Final

Assessment of MA240 Final Exam for Spring 2012

Goal: An applied mathematics major will be able to integrate and differentiate functions.

Assessment of goal: Problems 1-7 and 10-13 of the final exam required the students (directly or indirectly) to integrate or differentiate a function. Therefore, it is necessary for students to be able to integrate and differentiate functions in order to pass the final exam.

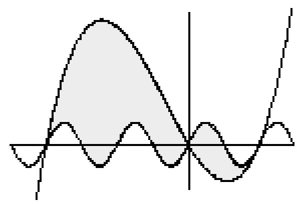
Goal: An applied mathematics major will be able to apply mathematics to at least two areas taken from biology, physics, chemistry, economics or computer science.

Assessment of goal: Problems 2 and 13 required students to apply calculus to solve application problems. The first applied to physics, while the other is more related to chemistry. However, the techniques used can be applied to a number of fields. Therefore, students who successfully complete this problem will be able to apply mathematics to at least two areas taken from biology, physics, chemistry, economics or computer science.

MA240 - Final Exam - Spring 2012

Je m'appelle ____

1. Let R be the region bounded by the curves $y = \dfrac{x^3 + 2x^2 - 8x}{3}$ and $y = \sin(\pi x)$. Note that these two functions intersect where they cross the x-axis.



   (a) (4 points) Set up, but do not evaluate, an integral (or integrals) that represents the area of R.

   (b) (4 points) Set up, but do not evaluate, an integral (or integrals) that represents the volume of the solid with a base that is the part of R to the *right* of the x-axis and has square cross sections when taken perpendicular to the x-axis.

   (c) (4 points) Set up, but do not evaluate, an integral (or integrals) that represents the volume of the solid generated by revolving the part of R to the *left* of the x-axis about the line $y = -3$.

Assessment of MA440 Final Exam for Fall 2011

Goal: An applied mathematics major will be to read and construct mathematical proofs in analysis and algebra.

Assessment of goal: Advanced calculus is the first course mathematics majors see in the more abstract area of mathematics known as analysis. A quick perusal of the final for this course will demonstrate to the reader that the entire course was devoted to reading and constructing mathematical proofs in analysis.

MA440 - Final Exam - Fall 2011

1. TRUE or FALSE?

   (a) There exists a function $f : \mathbb{R} \longrightarrow \mathbb{R}$ such that $f'(x) = [x]$.
   (b) If f satisfies a Lipschitz condition at x_0, then $f'(x_0)$ exists.
   (c) Suppose f and g are continuous on $[a, b]$ and differentiable on (a, b). Suppose further that g is strictly increasing on $[a, b]$. Then there exists $c \in (a, b)$ such that $\dfrac{f'(c)}{g'(c)} = \dfrac{f(b) - f(a)}{g(b) - g(a)}$.
   (d) If f is differentiable on (a, b), then f is uniformly continuous on (a, b).
   (e) It is possible to find two functions f and g such that f is integrable with respect to g over $[a, b]$, but g is not integrable with respect to f over $[a, b]$.
   (f) Suppose f is Riemann integrable on $[a, b]$, and let $F(x) = \int_a^x f(t)\ dt$ for $x \in [a, b]$. It is possible that there exists $c \in (a, b)$ such that $F'(c)$ does not exist.
   (g) A function with a finite number of discontinuites over $[a, b]$ is Riemann integrable over $[a, b]$.
   (h) If f is Riemann integrable over $[a, b]$ and g is monotonic increasing on $[a, b]$, then f is integrable with respect to g over $[a, b]$.
   (i) If f^2 is Riemann integrable over $[a, b]$, then f is Riemann integrable over $[a, b]$.
   (j) California girls, we're unforgettable...Daisy Dukes, bikinis on top.

2. Let $f : D \longrightarrow \mathbb{R}$ with $a \in D$ such that $f'(a)$ exists.

   (a) Prove $f'(a) = \lim\limits_{h \to 0} \dfrac{f(a+h) - f(a-h)}{2h}$.
   (b) Give an example of a function f and a specific value for a where the above limit exists, but $f'(a)$ does not exist.

3. Answer the following.

   (a) State the Mean Value Theorem.
   (b) Show that if $f'(x) > 0$ on (a, b), then for every pair $x_1, x_2 \in (a, b)$ with $x_1 < x_2$ we have $f(x_1) < f(x_2)$.
   (c) Suppose f and g are continuous on $[a, b]$ with $\int_a^b f = \int_a^b g$. Prove there exists $c \in (a, b)$ such that $f(c) = g(c)$.

4. Answer the following.

   (a) Define Cauchy sequence.
   (b) Prove directly (i.e. using this definition) that if $\{a_n\}$ and $\{b_n\}$ are Cauchy sequences, then $\{a_n + b_n\}$ is a Cauchy sequence.
   (c) Let $\{a_n\}$ be a sequence of real numbers. Prove that $\{a_n\}$ converges if and only if $\{a_n\}$ is a Cauchy sequence.

5. Let $f(x) = x^2 \sin\left(\dfrac{1}{x}\right)$ for $x \neq 0$ and let $f(0) = 0$.

   (a) Show that $f(x)$ is continuous at $x = 0$.
   (b) Using the definition of the derivative, find $f'(0)$.
   (c) Using derivative rules, write a rule for $f'(x)$.
   (d) Is $f'(x)$ continuous at $x = 0$? Why or why not?

(OVER)

Assessment of MA 208 Final Exam for Spring 2012

Goal: An applied mathematics major will be to read and construct mathematical proofs in analysis and algebra.

Assessment of goal: Problems 6 – 9 require students to construct proofs, while the rest of the exam requires students to understand the concepts presented in proofs in order to complete the problems. Therefore, students must be successful in reading and constructing mathematical proofs in analysis and algebra in order to pass this exam.

MA208 Spring 2012
Final

Assessment of MA 301 for Spring 2012

Goal: A mathematics education major will be able to pass the Illinois high school mathematics certification exam.

Assessment of goal: This course addresses the following Illinois State Board of Education and NCTM Content Standards.

Illinois State Board of Education: 3A, 3B, 3C, 9B, 9C3, 9D2, 9D3, 9E4, 9E8.
NCTM Content Standards: 3.1, 3.2, 3.3, 3.4, 6.1, 11.1, 11.2, 11.3, 11.4, 11.5, 11.6, 11.7, 15.1, 15.2

Further, this course addresses Subarea IV of the Illinois Certification Testing System Mathematics (115) exam. (http://www.icts.nesinc.com/PDFs/IL_field115_SG.pdf) An examination of the final exam will show that these indicators and standards have been addressed.

MA301 - Final Exam - Spring 2012

____ is my name-o!

1. Answer the following with either TRUE of FALSE.

   (a) ____________ In a protractor geometry, it is impossible to have a triangle with two right angles.

   (b) ____________ In a neutral geometry, the Side-Angle-Side Axiom is logically equivalent to the Angle-Side-Angle axiom.

   (c) ____________ In a protractor geometry based on r_0, if θ is a real number so that $0 < \theta < r_0$ and $\overrightarrow{BC}$ is in the edge of a half plane H_1, then there exists a unique point $A \in H_1$ so that $m(\angle ABC) = \theta$.

   (d) ____________ Suppose $\{\mathcal{P}_1, \mathcal{L}_1\}$ and $\{\mathcal{P}_2, \mathcal{L}_2\}$ are both incidence geometries. If $\mathcal{P} = \mathcal{P}_1 \cup \mathcal{P}_2$ and $\mathcal{L} = \mathcal{L}_1 \cup \mathcal{L}_2$, then $\{\mathcal{P}, \mathcal{L}\}$ is an incidence geometry.

   (e) ____________ Every metric geometry satisfies the Triangle Inequality.

2. For each of the following, give an example of a geometry (figures are OK) that illustrates the listed properties.

   (a) Two examples of abstract geometries that are not incidence geometries, each having exactly three points

   (b) A set that is convex in the Poincaré plane but is not convex in the Euclidean plane

   (c) A circle of radius 2 in the Taxicab plane not centered at the origin

   (d) An isosceles triangle in the max distance plane with base angles that are not congruent.

Assessment of MA 320 for Fall 2011

Goal: A mathematics education major will be able to pass the Illinois high school mathematics certification exam.

Assessment of goal: This course addresses Subarea I, item 0002 of the Illinois Certification Testing System Mathematics (115) exam. Specifically, this course provides students with the necessary requisites to "...demonstrate knowledge of the historical development of mathematics, including contributions of men and women from various cultures." (http://www.icts.nesinc.com/PDFs/IL_field115_SG.pdf)

Goal: A mathematics education major will know in broad terms the history of calculus, algebra, and probability.

Assessment of goal: A quick perusal of the final exam for this course will give the reader ample evidence that this goal has been met.

21. (10 points) Throughout this semester, we've seen many players in the game of solving quadratic, cubic, and quartic equations. For this question, write down as many facts as you can about these players. Appropriate answers include contributions they made, works they wrote, interactions between participants, interesting facts about their lives, etc. Every correct fact earns one point. *Every incorrect "fact" loses one point.* Note that this problem has the potential to earn you extra credit (if you provide more than 10 facts). However, I will not penalize you more than the 10 points this problem is worth by providing more incorrect "facts" than correct ones.

Approved Courses for VEE - (October 13, 2011)

The VEE requirement is jointly sponsored by the Society of Actuaries (SOA), Casualty Actuarial Society (CAS) and Canadian Institute of Actuaries (CIA).

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